Excess Return and Liquidity: Evidence from A Shares of the Shanghai Stock Exchange

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論 文 内 容 の 要 旨

Introduction

Asset pricing is the core part of modern finance. In order to guide investors' decisions, all kinds of asset pricing model always trying to find various factors that can affect asset price and explain the differences in yield. The core of classic asset pricing theory is the Capital Asset Pricing Model built by William Sharpe, Jone Lintner and Jan Mossin in 1960s. This model assumed that all of investors use Markowitz's portfolio theory to search portfolio in the active set. In this time, expected return and system risk is positive linear correlation. Although the Capital Asset Pricing Model provide a simple structure for theory relation between risk and return, Perfect theoretical assumptions encounter difficulties for explaining imperfect financial markets. A lot of empirical researches find anomalies that cannot be explained by the Capital Asset Pricing Model. For example, size effect, Book to Market effect and Momentum effect. These anomalies shake the position of the Capital Asset Pricing Model.

Aiming at the defect of the Capital Asset Pricing Model, Scholars have turned their study focus to find the appropriate theoretical and empirical model so that decision-making process can be

explained better. Ross (1976) advanced the arbitrage pricing theory (APT) and tried to find more suitable pricing model. APT believes that stock return is a linear function of k factors, and all of these factors are the basic factors that describe the economic system. But APT does not point out the specific factors' numbers and content. Fama and French (1992) investigate explanatory power of Size, Book-to-market ratio and beta, and find that after controlling the size and book-market ratio, beta cannot explain stocks' return. Based on the results of this test, Fama and French(1993) introduced new size factor, new Book-to-Market factor and Market factor very delicately, and then they set up a three-factor model, which can explain return very well. But it is difficult to explain economic implications of the three factors.

We know liquidity and price discovery are two basic functions of financial markets. Liquidity of the secondary market not only provides investors with opportunities of transferring and trading of stocks, but also provides financing premise for capital raiser. If the lack of liquidity leads to transaction cannot be completed smoothly, then market will lose its necessity of existence. On the other hand, liquidity also affects firm's best equity structure, because equity separation helps to improve liquidity. At the same time, high liquid market can make major shareholders cover up information superiority obtained by their supervision authority effectively. Because major shareholder can earn a big profit from those information superiority, high liquidity will increase shareholder's oversight power. It is because of these reasons, Amihud and Mendelson(1986) point out : Liquidity, marketability or trading costs are among the primary attributes of many investment plans and financial instruments. In a larger sense, Liquidity not only can ensure the normal functioning of the financial markets, but also can promote the efficient allocation of resources.

But, the classic capital asset pricing model and arbitrage pricing theory assume that traders' trading behavior will not have an impact on asset prices. However, the reality of market is not perfect, there are a variety of transaction costs, and asymmetric information exists in investors. So the realistic market is not fully liquid. Sometimes, the depressed market can result in liquidity's decline or disappearance. For example, the stock market crash in October 1987 and the Asian financial crisis in 1997. Then, liquidity is reflected in asset pricing?

Early researches were mainly focus on liquidity level and came to the conclusion that liquidity and return are negative relation. Amihud and Mendelson(1986) do an initiative research on the relation between liquidity and asset pricing, and put forward liquidity premium theory. They believe that illiquid assets have higher return, and liquid assets have low expected return. Datar, Naik and Radcliffe (1998) provide an alternative test of Amihud and Mendelson's model using the turnover ratio as a proxy for liquidity. They find that illiquid stocks provide higher average returns.

In the last decades, scholars begin turn their focus to the relation between liquidity risk and asset pricing. For example, Pastor and Stambaugh (2003) find that expected stock returns are related cross

section to the sensitivities of stock returns to innovations in aggregate liquidity. Stocks that are more sensitive to aggregate liquidity have substantially higher expected returns, even after controlling for exposures to the market return as well as size, value, and momentum factors. It proves that market-wide liquidity is a state variable and important for asset pricing. Liu (2006) develops a new two-factor (market and liquidity) model and examines the common stocks on the U.S. market. His empirical evidence shows that a significant liquidity risk premium exists based on both non-traded and traded liquidity factors, indicating that liquidity risk is priced, and liquidity risk is important for asset pricing. From the opposite view of liquidity, Li, Sun and Wang (2011) examine Japanese stock market and find that the expected illiquidity has a positive and significant impact on expected stock returns, the unexpected illiquidity has a negative and significant impact on contemporaneous stock returns.

Another important thing is as presented in many studies, most of empirical studies are conducted based on the US market or other developed market. The studies about liquidity and excess return based on the emerging market are relative few. Particularly, in China, which is one of the fastest growing emerging markets with different characteristics of investors' behavior and ownership structure, there are a few of characters are different with the developed market. Firstly, Macroeconomic policies affect the stock market. Secondly, the excessive government policy intervention leads to frequent fluctuations in the markets. Thirdly, macroeconomic policies lack of Continuity and stability, and new policies and new measures appear continually. Another character of China's market is that there is no risk hedging mechanism. When the market is too prosperous or too weak, there is no reverse mechanism which can make it back to rational and balanced level. Therefore, Government's policies can cause fluctuations in stock market.

In the early 1990's, from the point of investor composition, because there are no institutional investors, the main investors are individuals. Even in 2011, individual investors still occupied a predominant position, their trade volume accounted for 83.5% in total trade volume, and institutional investors' trade volume accounted for 16.5%. For individual investors, they lack the necessary financial knowledge, and investment behaviors are not rational. On the other hand, they have no long-term investment objectives. Therefore, Chinese stock market is of highly speculative. The purpose of this paper is to test the relation between liquidity and excess return on China's market. Firstly, this paper investigates whether a liquidity premium exists on China's market or not. Secondly, what is the relationship between liquidity and excess return?

By examining a sample of A-share firms listed in Shanghai Stock Exchange (SSE) over the period from 1995 to 2012, this paper suggests meaningful and significant results, which are different from the developed markets. First, this paper identify that there is a very significant liquidity premium in A shares of The Shanghai Stock Exchange. Secondly, this paper finds that stocks with high liquidity

have a low excess return, but low liquidity stocks do not present high return, middle level liquidity stocks are of mixed situation. This is different from the majority of results that illiquid assets have higher return, and liquid assets have low expected return.

2 Data

Although tradings in the Shanghai Stock Exchange have begun in 1991, there were only 185 shares in A shares of the Shanghai Stock Exchange in 1995. In order to ensure enough shares to divide them into groups in each year, the data between 1991 and 1994 have to be abandoned. I use monthly data from the Shanghai stock market from January 1995 to December 2012, giving 198 observations for each variable. The number of shares in the sample increase from 185 in 1995 to 861 in 2012. Portfolios are constructed by weighting returns by listed market values, calculated as the product of the total number of listed (tradable) shares and the market price of the shares. Exceptionally, for the size portfolio, the weighting is by total market capitalization. It seems reasonable to argue that the non-tradble part of each issue would not contribute directly to pricing the shares, whereas it clearly does contribute to the size of the company.

All the data come from the China Stock Market and CSMAR Database developed by the GTA IT Co. Ltd. To be included in the final sample, the following criteria must be satisfied:

(1) All of firms are not financial institutions or ST firms. Firms with CSRC's (China Securities Regulatory Commission) Industry Classification of I (finance and insurance) are excluded from the sample.

(2) Firms should have trading day of more than 200 days, and no missing data about stock returns and financial statement.

(3) The data should be made of monthly return, size, book-to-market and illiquidity.

3 Methodology

Pastor and Stambaugh(2003) find that market-wide liquidity is a state variable which is important for pricing common stocks. They lead a liquidity factor into Fama-French model(1993), and find Stocks which are more sensitive to aggregate liquidity have substantially higher expected returns, even after controlling for exposures to the market return as well as size, value, and momentum factors.

Motivated by their research method, this paper leads another liquidity factor which is different from that of Pastor and Stambaugh(2003) into Fama-French model(1993). Using this model, this paper can research liquidity premium character of China's market.

After balancing many liquidity measures, I find that not only do Amihud's (2002) illiquidity measure easy to calculate, but also is used widely by researchers. So, it is an ideal measure for China's market. The illiquidity is the daily ratio of absolute stock return to its dollar volume, averaged over some period. It can be interpreted as the daily price response associated with one dollar of trading

volume, thus serving as a rough measure of price impact.

Amihud (2002) define

$$ILLIQ_{i,y}=\frac{1}{D_{i,y}}\sum_{t=1}^{D_{i,y}}\frac{|R_{i,y,d}|}{VOLD_{i,y,d}} \quad (1)$$

as the liquidity proxy.

$ILLIQ_{i,y}$ represents stock i's illiquidity in year y;

$D_{i,y}$ represents the number of days for which data are available for stock i in year y;

$R_{i,y,d}$ represents the return on stock i on day d of year y;

$VOLD_{i,y,d}$ represents daily volume on stock i on day d of year y;

In this paper, I use monthly data, so liquidity proxy will become easily, just like this

$$ILLIQ_{i,t}=\frac{|R_{i,t}|}{VOLD_{i,t}}X10^{3} \quad (2)$$

$R_{i,t}$ represents the return on stock i on month t (currency: YUAN);

$VOLD_{i,t}$ represents monthly volume on stock i. on month t (currency: YUAN)

Because of the value of $\frac{|R_{i,t}|}{VOLD_{i,t}}$ is very small, It is necessary to multiply a coefficient of 10^{3}.

3.1 Evidence of a liquidity premium

In this part, I discuss the test for a liquidity premium. In short, I sort stocks into 10 portfolios in accordance with illiquidity based on the ILLIQ index; this test will check the return of the next month for each portfolio. If the lower the liquidity of month T, the higher the return of month T +1, that is, the least liquid portfolio consistently outperforms the most liquid portfolio, this is an evidence of the presence of a liquidity premium in Chinese market.

Table 1 presents the performance and characteristics of equally weighted decile portfolios formed on the illiquidity measure. In moving from the least illiquidity decile (0) to the most illiquidity decile (9), the mean portfolio holding-period return increases almost monotonically. The mean of decile (0) is 1.97%, while the mean of decile (9) is up to 3.26%. Looking at the results of decile (0) and decile (9), portfolio decile (9) - decile (0) reveals significant premiums of 1.29% per month. These results indicate that the illiquidity measure ILLIQ predicts stock returns over the next month.

Table 1

Number of groups	observation	mean	median	t-value	Pr>|t|	std deviation	Std Err
0	214	0.0197	0.015	3.13	0.0021	0.092	0.006
1	214	0.0198	0.0125	2.85	0.0048	0.101	0.066
2	214	0.0207	0.0149	3.08	0.0023	0.098	0.006
3	214	0.0253	0.0201	3.52	0.0005	0.105	0.007
4	214	0.0255	0.0148	3.61	0.0004	0.103	0.007
5	214	0.0278	0.0195	3.91	0.0001	0.103	0.007
6	214	0.0259	0.0151	3.63	0.0004	0.104	0.007
7	214	0.0296	0.0228	4.00	<.0001	0.108	0.007
8	214	0.0282	0.0258	3.89	0.0001	0.106	0.007
9	214	0.0326	0.0276	4.29	<.0001	0.111	0.007

3.2 Is Liquidity Risk Priced?

This section investigates whether a stock's expected return is related to the sensitivity of its return to the innovation in aggregate liquidity, $LIQ_{i,t}$. Sensitivity, denoted for portfolio *i* by its liquidity beta β_i^L , is the slope coefficients on $LIQ_{i,t}$ in a multiple regression in which the other independent variables are additional factors considered important for asset pricing. The models considered in this paper are the Fama-French three-factor model, and a four factor model with liquidity factor, which was used by Pastor and Stambaugh(2003). This paper uses a different LIQ, which is come from Amihud's illiquidity. Specifically, I run the following regressions.

$$R_{i,t} - R_{f,t} = \alpha_i + \beta_i^M MKT_t + \beta_i^S SMB_t + \beta_i^H HML_t + \varepsilon_{i,t} \quad (3)$$

$$R_{i,t} - R_{f,t} = \alpha_i + \beta_i^M MKT_t + \beta_i^S SMB_t + \beta_i^H HML_t + \beta_i^L LIQ_{i,t} + \varepsilon_{i,t} \quad (4)$$

Where $R_{i,t}$ is the return on portfolio *i* at time t, $R_{f,t}$ is the risk-free rate at time t, which is the one-year deposit rate. $R_{i,t} - R_{f,t}$ denotes portfolio *i*'s excess return, *MKT* denotes the excess return on a broad market index, and the other two factors, *SMB* and *HML*, are constructed by sorting stocks according to market capitalization and book-to-market ratio. According to a statement of Pastor and Stambaugh(2003), the definition of β_i^L captures the asset's comovement with aggregate liquidity that is distinct from its comovement with other commonly used factors.

3.3 Theoretical hypotheses for liquidity

My null hypothesis is that if liquidity is not priced in the Shanghai stock market, Fama-French three-factor model should capture all the time-series variation in portfolio returns and the intercepts in these time-series regressions should be jointly equal to zero. I use the GRS F-test to check whether the intercepts are jointly equal to zero. The alternative hypothesis is that if liquidity is

priced, liquidity risk helps explain the unbeknown component of returns in the Fama-French three-factor asset-pricing model. If liquidity is significant, this hypotheses can be accepted, and market liquidity explains at least part of the portfolio returns that are not explained by the Fama-French factors.

3.4 Construction of the Tested Portfolios

Following Fama and French (1993), the data were formed into 25 portfolios sorted by size and book-to-market ratio. At the end of June year T, stocks were sorted into five separate size groups from small (S1) to big (S5). At the end of December of year T-1, according to book-to-market, stocks are sorted into 5 groups which are from low (B1) to high (B5). The 25 portfolios are constructed by finding the intersection between each size and book-to-market group: the intersection of the smallest size (S1) and lowest book-to-market (B1) is identified as portfolio S1B1, and so on. This intersection reduces the noise generated by individual stocks and helps to generate normally distributed portfolio returns. In addition, since the Fama-French portfolios have become a benchmark in tests of asset-pricing models, using these 25 portfolios makes it easier to compare my results with other studies.

3.5 Construction of risk factors

Following Fama and French (1996), the three risk factors are constructed to mimic risk related to: the aggregate market, company size and book-to-market ratio. The excess market return is the monthly return on the market of A Shares less the risk-free rate. To construct the size and book-to-market factors, all stocks were first ranked separately by their size (total market value at the end of June of year T) and book-to-market ratio (at the end of December of year T-1). Then, two size and three book-to-market portfolios were formed using a 50 per cent breakpoint for size (S and B) and 30 per cent and 70 per cent breakpoints for book-to-market (L, M and H). Lastly six value-weighted portfolios were formed from the intersections of the size and book-to-market groups. The SMB factor (Small minus Big) is the value-weighted average of the difference between returns on small-size stock portfolios and returns on big size portfolios, balanced so as to be neutral with respect to book equity. Similarly, the HML factor (High minus Low) is the value-weighted average of the difference between returns on high book-to-market stock portfolios and returns on low book-to-market portfolios, balanced so as to be neutral with respect to size. The calculation of SMB factor and HML factor are given by

$$SMB_t = \left[\frac{(S/L)_t + (S/M)_t + (S/H)_t}{3}\right] - \left[\frac{(B/L)_t + (B/M)_t + (B/H)_t}{3}\right] \quad (5)$$

and

$$HML_t = \left[\frac{(S/H)_t + (B/H)_t}{2}\right] - \left[\frac{(S/L)_t + (B/L)_t}{2}\right] \quad (6)$$

Where

$(S/L)_t$: means small company and low book-to -market.

$(S/M)_t$: means small company and middle book-to -market.

$(S/H)_t$: means small company and high book-to -market.

$(B/L)_t$: means big company and low book-to -market.

$(B/M)_t$: means big company and middle book-to-market.

$(B/H)_t$: means big company and high book-to-market.

SMB: a risk factor related to size.

HML: a risk factor related to book-to-market.

3.6 construction of liquidity factor

The construction of the liquidity mimicking portfolio is as follows. I first rank stocks by ILLIQ measure of each month in the ascending order. The ratios, from low to high, are 30%, 40% and 30%. I define the lower 30% portfolio as high-liquidity($HL_{t,c}$) portfolio, and the higher 30% portfolio as low-liquidity($LL_{t,c}$) portfolio. $LL_{t,c}$ contains stocks that are recognized as the least liquid, and $HL_{t,c}$ contains stocks that are recognized as the most liquid.

The liquidity mimicking, portfolio, $LIQ_{t,c}$, is then defined as the return difference between the low-liquidity($LL_{t,c}$)portfolio and the high-liquidity($HL_{t,c}$) portfolio. It is given by

$$LIQ_{t,c}=LL_{t,c}-HL_{t,c} \tag{7}$$

Using Amihud's(2002) ILLIQ measure, I have confirmed the existence of liquidity premium. Undoubtedly, $LIQ_{t,c}$ will capture characters of liquidity premium.

4 Empirical Results

4.1 Results for 25 portfolios

Table 3 reports the regression results on the four factors of MKT, SMB, HML, and LIQ. The left side represents the size factor, the upper side represents book-to-market factor. From the first portfolio to the 25th portfolio, I compare Fama-French three-factor model with my four-factor model, and find that there are no changes between the 25 signs and the number of significant T value for intercepts, And that with the changes of size (from small size to big size) and book-to-market ratio (from low to high), the sign's change do not show obvious regularity. On the other hand, I also find that most of four-factor model's intercepts are smaller than that of three-factor model. 13 intercepts of 25 portfolios are much closer to the origin of the coordinate, which is account for 52%. The GRS F-test rejects the null hypothesis that the intercepts are jointly equal to zero at 5% level (reported in table 6), but do not reject the null hypothesis at 1% level. This indicates the liquidity risk, to some extent, explains the missing parts of Fama-French three-factor model. Then I check the coefficient of LIQ factor in my four-factor model, and find 14 of 25 coefficients are significant and negative. This

result suggests that there is a significant negative correlation between liquidity risk and excess return. But, when size and book-to-market ratio change from low to high, the results do not show any changing trends or rules.

In other factor's coefficient aspect, as documented study in Keith S.K. Lam and Lewis H.K. Tam (2011), in the model containing a liquidity factor, the average MKT coefficient is also close to 1.0, and the coefficients are very large and significant. When I check the coefficients of SMB, I find they are very different from other studies. Out of 25 portfolios, the coefficients of the smallest size of five portfolios, three of them are negative. And the coefficients of the biggest size of five portfolios, four of them are negative. These results indicate that excess return and size are negative relation in these two extreme cases. This result is different from Fama-French three-factor result that the coefficients on SMB decrease monotonically from smaller- to bigger-size quintiles. The rest of the coefficients of SMB decreases as size increases, the result of this part is consistent with that of Fama-French three-factor model.

For HML factor, in every size quintile of stocks, most of the HML coefficients increase monotonically from strong negative values for the lowest book-to-market quintile to strong positive values for the highest book-to-market quintile. This is consistent with the result of Fama and French(1993).

Lastly, I check the adjusted R square of Fama-French three-factor model and my four-factor model, all of them are above 0.99, which suggests that the two models are applicable to A Shares of the Shanghai Stock Market.

Table 3 (The data with star represent T value of estimates.)

My four-factor model and 25 portfolios						
book-to-market						
intercepts and T values						
		1	2	3	4	5
size	1	0.001011 *0.110051	-0.00126 *-0.1365	0.007465 *0.756877	0.001044 *0.1261	0.008244 *0.87769
	2	0.009174 *1.986409	0.004905 *1.096573	0.008752 *1.834783	-0.00803 *-1.52075	0.004917 *0.929092
	3	-0.00699 *-1.12727	0.001079 *0.187066	0.003058 *0.609643	-0.00116 *-0.21154	0.005227 *1.03846
	4	-0.00154 *-0.21755	0.000973 *0.166678	0.014115 *2.54769	-0.0024 *-0.42464	0.00022 *0.041138
	5	0.002365 *0.420222	0.005594 *1.173501	0.003193 *0.560989	-0.00969 *-1.61279	-0.00167 *-0.32057
coefficient of MKT and their T values						
	1	0.997188 *358.5426	0.996236 356.0891	0.999739 329.6137	0.99706 396.6758	0.997061 396.6758

Table3(continued)

	2	1.003205	1.001769	1.002707	0.998024	1.002113
		* 709.07	* 731.0686	* 686.208	* 616.772	* 618.106
size	3	0.999292	1.000972	1.001571	0.999806	1.002828
		* 526.2728	* 566.3906	*651.7916	* 593.798	* 650.424
	4	1.000486	0.999981	1.005836	0.999666	0.999972
		* 461.658	* 559.400	* 592.634	*577.729	*610.633
	5	1.000288	1.001858	1.001992	0.997655	0.998379
		*580.129	* 686.122	*574.728	*541.956	*626.514
coefficient of SMB and their T values						
	1	0.026001	-0.04626	-0.06598	-0.69366	0.984947
		*0.18066	*-0.51402	*-1.74986	*-6.45175	*5.652523
	2	1.064753	0.980329	0.95489	0.928086	0.87132
		*20.59235	*19.57583	*17.88106	*15.69387	*14.70559
size	3	0.831611	0.681222	0.791007	0.633842	0.754152
		*11.98386	*10.54728	*14.08526	*10.30059	*13.38403
	4	0.350155	0.259762	0.461203	0.442011	0.300236
		*4.421074	*3.976168	*7.435486	*6.989723	*5.016635
	5	-0.30646	-0.15371	-0.21519	-0.27371	-0.30203
		*-4.86335	*-2.8805	*-3.37729	*-4.06852	*-5.18617
coefficient of HML and their T values						
	1	0.132475	0.158099	-0.05868	-0.80512	0.321008
		*1.246789	*1.253267	*-0.40359	*-6.41228	*2.500322
size	2	-0.38161	-0.290000	0.184999	0.180327	0.404095
		*-6.42106	*-5.0382	*3.013954	*2.652952	*5.933569
	3	-0.60392	-0.05402	0.049587	0.185867	0.425715
		*-7.57151	*-0.72772	*0.768217	*2.627914	*6.573175
	4	-0.32816	-0.1438	0.130308	0.23945	0.587908
size		*-3.6048	*-1.91503	*1.827751	*3.294355	*8.546484
	5	-0.59222	-0.43892	0.086834	0.370148	0.830217
		*-8.17648	*-7.15597	*1.185693	*4.786795	*12.4026
coefficient of LIQ and their T values						
	1	-0.04086	-0.06184	-0.10189	-0.10961	-0.14608
		*-1.15658	*-1.82835	*-2.93292	*-4.00369	*-4.58068
	2	-0.00307	-0.01734	-0.03045	-0.00408	-0.03278
		*-0.20709	*-1.20827	*-1.99009	*-0.24059	*-1.93074
size	3	-0.04142	-0.0424	-0.0134	-0.042	-0.00315
		*-2.08335	*-2.29156	*-0.83295	*-2.38238	*-0.19486
	4	-0.04655	-0.04569	-0.02161	-0.02991	-0.05277
		*-2.05128	*-2.44125	*-1.21579	*-1.65072	*-3.07773
	5	0.020679	0.002368	-0.04673	-0.03279	-0.04231
		*1.145369	*0.154868	*-2.55996	*-1.70105	*-2.53597

Table3(continued)

		1	2	3	4	5
Adj R-Sq	1	0.9985	0.9985	0.9983	0.9988	0.9984
	2	0.9996	0.9996	0.9995	0.9995	0.9995
	3	0.9993	0.9994	0.9995	0.9995	0.9995
	4	0.9995	0.9991	0.9994	0.9995	0.9994
	5	0.9995	0.9994	0.9996	0.9994	0.9993

4.2 A new portfolio method

In the above analysis, what puzzle me is why the LIQ's coefficients do not have obvious regularity with changes of size and book-to-market ratio. One of possible reasons is that liquidity risk mixed with the size factor and book-to-market factor. Perhaps, liquidity risk should be separated from size and book-to-market ratio factors.

Following Fama-French method, I construct 27 portfolios sorted by size, book-to-market ratio and illiquidity index. The 27 portfolios are constructed by finding the intersection among each size, each book-to-market ratio and each illiquidity index group.

In able 5, I find a regularity about coefficients of LIQ. After controlling for size and book-to-market ratio, I find T values of the highest LIQ are always statistically significant and negative, and T values of the lowest LIQ are always statistically insignificant. While the T values of middle LIQ are not regularity, some of them are statistically insignificant, and the others are statistically significant and negative. Compared with Lam and Tam's (2011) result that the LIQ coefficients tend to be positive for small firms and negative for big firms, and positive for illiquid firms and negative for liquid firms, stocks in A Shares of Shanghai Stock Exchange are different. No matter big or small firms, the LIQ coefficients tend to negative, and only the biggest one of three LIQ deciles is statistically significant. This result indicates that there is a clearly negative correlation between the biggest LIQ and excess return. On the other hand, although the smallest LIQ coefficients are statistically insignificant, 4 negative coefficients and 4 positive coefficients out of 8 LIQ coefficients. This suggests that holding stocks with the lowest LIQ cannot guarantee investors always earn more excess return, and holding stocks with the highest LIQ always gain less excess return.

From 25-portflio regression analysis to 27-portfolio regression analysis, the statistically insignificant coefficients of SMB and HML increased slightly. The SMB has 3 statistically insignificant coefficients out of 25-portflio regression, and 6 out of 27-portfolio regression. The HML has 8 statistically insignificant coefficients out of 25-portflio regression, and 10 out of 27-portfolio regression. Although statistically insignificant coefficients increased, the relation between liquidity and excess return is more clearly. Lastly, the GRS F-test results, which are 1.57 for 25 portfolios

and 2.5 for 27 portfolios. Obviously, 27-portfolio model is better than 25-portfolio model.

Table 5 (The data with star represent T value of estimates.)

My four-factor model and 27 portfolios									
LL						ML			
book-to-market						book-to-market			
intercepts						intercepts			
		1	2	3			1	2	3
size	1	-0.0066 *-0.749	0.005045 *0.56245	-0.0067 *-1.2178		1	-0.00747 *-0.7713	-0.00569 *-0.786	-0.02251 *-3.41843
	2	-0.0064 *-0.916	-0.01259 *-2.28438	-0.00447 *-0.6952	size	2	-0.0104 *-1.9807	-0.00217 *-0.4392	-0.00916 *-1.65348
	3	-0.0077 *-1.186	0.010296 *1.56690	-0.00427 *-0.6840		3	0.01404 *2.1432	0.00584 *1.0296	0.005351 *0.80035
coefficient of MKT						coefficient of MKT			
size	1	0.99918 *363.98	1.00396 *363.47	1.00218 *586.59		1	1.000225 *334.09	1.002974 *448.55	0.99760 *488.52
	2	0.99977 *455.05	0.99636 *582.09	1.00171 *502.03	size	2	0.999079 *612.727	1.002465 *651.929	1.00159 *582.16
	3	0.99484 *490.90	1.00297 *491.46	0.99622 *514.41		3	1.004905 *493.936	1.001095 *567.995	1.00026 *481.73
coefficient of SMB						coefficient of SMB			
size	1	-0.04272 *-0.30711	-0.5652 *-4.963	0.85197 *14.306		1	-0.04187 *-0.43961	1.437964 *10.9611	1.07737 *15.022
	2	0.582788 *7.41182	0.6240 *10.18	0.67686 *9.4786	size	2	0.758295 *12.9945	0.715922 *13.0092	0.66201 *10.751
	3	-0.46104 *-6.35667	-0.2213 *-3.033	-0.28302 *-4.0834		3	0.086224 *1.18420	0.046708 *0.74047	-0.0570 *-0.767
coefficient of HML						coefficient of HML			
size	1	0.118227 *1.120536	-0.7310 *-5.279	0.43631 *6.1606		1	0.171123 *1.30259	0.857215 *9.10309	0.34938 *4.0969
	2	-0.09012 *-0.99069	0.1649 *2.327	0.52156 *6.3132	size	2	-0.28989 *-4.29387	0.030501 *0.47906	0.19409 *2.7246
	3	-0.25116 *-2.99328	0.1250 *1.479	0.70224 *8.7578		3	-0.81902 *-9.72275	-0.06359 *-0.87135	0.51879 *6.0345
coefficient of LIQ						coefficient of LIQ			
	1	0.018943 *0.591538	-0.0238 *-0.802	-0.00942 *-0.5609		1	-0.01779 *-0.53859	0.968377 *10.5298	- 0.05114 *-2.581

Table 5 (continued)

size	2	-0.00456	0.0247	0.05219	size	2	-0.00499	-0.01319	-0.0097
		*-0.21942	*1.527	*2.7629			*-0.323	*-0.90608	*-0.601
	3	0.020598	-0.0088	0.02281		3	0.002022	-0.05281	-0.0444
		*1.073584	*-0.455	*1.2445			*0.10496	*-3.16471	*-2.255

		1	2	3			1	2	3
Adj R-Sq	1	0.9984	0.9986	0.9993	Adj R-Sq	1	0.9985	0.9989	0.999
	2	0.9995	0.9994	0.9994		2	0.9995	0.9994	0.999
	3	0.9995	0.9994	0.9989		3	0.9995	0.9994	0.999

HL				
book-to-market				
intercepts				
		1	2	3
size	1	-0.005412	0.000791	-0.00686
		*-0.52831	*0.123796	*-1.08024
	2	0.004922	0.012697	-0.00076
		*0.635097	*1.697248	*-0.10913
	3	0.018174	0.014026	0.00244
		*2.670804	*2.035806	*0.312173
coefficient of MKT				
size	1	0.999444	1.00449	1.003457
		*314.353	*505.2918	*509.1555
	2	1.003544	1.007025	1.002051
		*416.9506	*433.4619	*462.1846
	3	1.004589	1.002062	0.999441
		*475.369	*468.3164	*411.7317
coefficient of SMB				
size	1	-0.12333	1.222497	1.182019
		*-3.26303	*17.75761	*16.75829
	2	0.834541	0.936084	0.86889
		*9.688345	*11.25848	*11.19811
	3	0.350696	0.152566	0.057303
		*4.636889	*1.992305	*0.659609
coefficient of HML				
size	1	-0.28155	-0.08669	0.133142
		*-1.92646	*-1.05096	*1.631611
	2	-0.66298	-0.14233	0.282094
		*-6.65273	*-1.47959	*3.142466
	3	-0.50335	0.197165	0.531934
		*-5.75264	*2.225493	*5.292557
coefficient of LIQ				

Table 5(continued)

size	1	-0.10322 *-2.91104	-0.03803 *-1.9359	-0.0583 *-3.12447
	2	-0.05753 *-2.52486	-0.04662 *-2.11976	-0.04063 *-1.97936
	3	-0.04687 *-2.34252	-0.08826 *-4.3571	-0.09484 *-4.12691

Adj R-Sq				
		1	2	3
	1	0.9982	0.9992	0.9993
	2	0.9991	0.9995	0.9993
	3	0.9992	0.9993	0.9992

Table 6

I test the multi-beta version of the Sharpe-Lintner asset-pricing model using Shanken's extension (Shanken, 1992) of the Gibbons-Ross-Shanken test (Gibbons et al., 1989). The F-statistic is given by

$$F = \frac{T-N-K}{N}\,\frac{\alpha'\hat{\Sigma}^{-1}\alpha}{1+R'\Omega^{-1}R} \sim F(N,T-N-K)$$

Where, for 25 portfolios, T =198 observations in the time series; K = 3 for three-factor regression and k=4 for four-factor regression; $\alpha = (\alpha_1, \ldots, \alpha_N)'$ is the (column) vector of the 25 regression intercepts.; Σ =the estimated residual covariance matrix from the 25 estimates of (1); R is the 4 x 1 vector of time means of RM, SMB, HML and LIQ; and Δ is their covariance matrix.

For 27 portfolios, T =197 observations in the time series; K = 3 for three-factor regression and k=4 for four-factor regression; $\alpha = (\alpha_1, \ldots, \alpha_N)'$ is the (column) vector of the 25 regression intercepts.; Σ =the estimated residual covariance matrix from the 27 estimates of (1); R is the 4 x 1 vector of time means of RM, SMB, HML and LIQ; and Δ is their covariance matrix.

	25-porfolio regression (three factors)	27-porfolio regression (three factor)	25-porfolio regression (four factors)	27-porfolio regression (four factors)
F-statistic	1.573	2.500	1.587	2.484
significance level(5%)	Significant	Significant	Significant	Significant
significance level(1%)	Insignificant	Significant	Insignificant	Significant

5 Conclusion

Researchers have documented the role of liquidity risk in explaining the cross-section of stock returns over the last decade. In this paper, I mainly investigate whether liquidity has significant effect on stock returns after accounting for well-known stock-return factors. Although these are well-known factors in explaining stock returns in the US, their joint effect with liquidity is seldom studied in China.

I adopt a time-series regression approach to study the return-liquidity relation by employing a new liquidity proxy in my study.

25-portfolio model draw a rough conclusion that liquidity and excess return has a negative

relation.

27-portfolio model draw a more clear conclusion that holding stocks with the lowest LIQ cannot guarantee investors always earn more excess return, and holding stocks with the highest LIQ always gain less excess return. This is a result that is different from developed markets.

My results show that liquidity is an important factor pricing returns in the Shanghai stock exchange after taking well-documented asset pricing factors into consideration.

論 文 審 査 結 果 の 要 旨

本論文は、中国の上海証券取引所に上場するＡ株式について、流動性ファクターの存在と流動性リスクのリスク・プレミアムの存在について分析した実証研究である。対象期間は、1995 年 7 月から 2012 年 6 月までの 17 年間であり、月次のデータを使用して分析を行っている。

まず、Amihud(2002)を参考に独自の非流動性を表す月次の指標を作成している。具体的には、株式の月次収益率の絶対値を月次の出来高で除したものである。この指標を元に毎月末に指標順に十分位ポートフォリオ（等金額ポートフォリオ）を作成し、1995年1月から2012年12月まで運用したときの平均収益率が示される。結果として高流動性銘柄からなる第1ポートフォリオの平均収益率は1.97％であり、2番、3番と順に流動性が低いポートフォリオの平均収益率は単調に増加していき、最も流動性が低い第10ポートフォリオの平均収益率は3.26％であった。この結果より他のファクターの影響は考慮されていないが、流動性が低い株式からは超過リターンが得られることがわかる。

次に、ファマ＝フレンチの3ファクター・モデルと同じ手法で、規模ファクター(SMBファクター)と簿価時価比率ファクター(HMLファクター)を作成する。さらに、簿価時価比率ファクターと同様の手法で先に作成した非流動性指標により、上位30％の株式から成るポートフォリオと下位30％の株式から成るポートフォリオの収益率の差を「流動性ファクター」として作成する。これらの準備をした上で、3ファクター・モデルと流動性ファクターを加えた4ファクター・モデルの比較を行い、流動性ファクターがファクター・モデルの説明力を向上させるか、流動性ファクターの値が性質の異なるポートフォリオに対して有意に正または負の係数を取るかなどの確認を行う。分析対象ポートフォリオは、規模と簿価時価比率の大きさで株式を5つに分けたグループの組合せによる25のポートフォリオと規模、簿価時価、流動性について3つに分けたグループの組合せによる27のポートフォリオの2通りである。

25個のポートフォリオに関する3ファクター・モデルの結果は、(1)25の切片のうち有意に0と異なるものは2つだけだったが、Gibbons-Ross-Shanken(GRS)テストの結果からはすべての切片が0であるという仮説は棄却され、3ファクターの他に株式価格を決定するリスク・ファクターが存在する可能性が示唆される、(2)ファクターの係数は、市場ファクターの係数は1であり、SMBファクターの係数は概ね規模が小から大になると減少し、HMLファクターの係数は概ね簿価時価比率が小から大になると増加し、先

行研究と同様の結果が得られた、(3)決定係数はすべて99.8%以上だった、というものだった。25個のポートフォリオに対する4ファクター・モデルの結果は、(1)25の切片のうち有意に0と異なるものは2つだが、全般的に切片は0に近づいた、しかしGRSテストの結果に改善は見られなかった、(2)流動性ファクターの係数は、規模が小さいと大きい負の値となり、また簿価時価比率が大きいと大きい負の値を取る傾向があり、事前の予想と一致した、(3)他のファクターの係数および決定係数は、3ファクター・モデルの結果と大差なかった、であった。

次に27個のポートフォリオに関する結果は、(1)3ファクター・モデルと4ファクター・モデルともに切片に関する結果は有意に0と異なる切片の数においてもGRSテストにおいても悪化した、(2)各ファクターの係数は、事前の予想通りの結果が得られた、であった。

本研究では、中国株式市場に関して、独自の流動性指標を作成し、この流動性指標に基づいて作成した流動性の大きさ順ポートフォリオのきわめて長期の運用成果が予想通りではあるが、流動性が低いほど高い運用成果を挙げたという独自の事実を示している。また、現在では標準モデルとなっているファマ＝フレンチの3ファクター・モデルに流動性ファクターを加えた4ファクター・モデルの検証を通じて、流動性ファクターの存在とそのリスク・プレミアムの存在を明らかにしようとした。独自に作成した流動性指標の実質的意味の検討など今後に課題は残されているが、中国株式市場において流動性が株価形成に与える影響を包括的に分析した点は評価できる。

以上より本論文は博士（経営学）論文として「合格」であると判定する。